(12) UK Patent Application (19) GB (11) 2 171 796 A

(43) Application published 3 Sept 1986

(21) Application No 8505311

(22) Date of filing 1 Mar 1985

(51) INT CL⁴
G01F 23/00

(52) Domestic classification (Edition H):
G1H 4AX 4BX
U1S 2019 G1H

(56) Documents cited
None

(58) Field of search
G1H
Selected US specifications from IPC sub-class G01F

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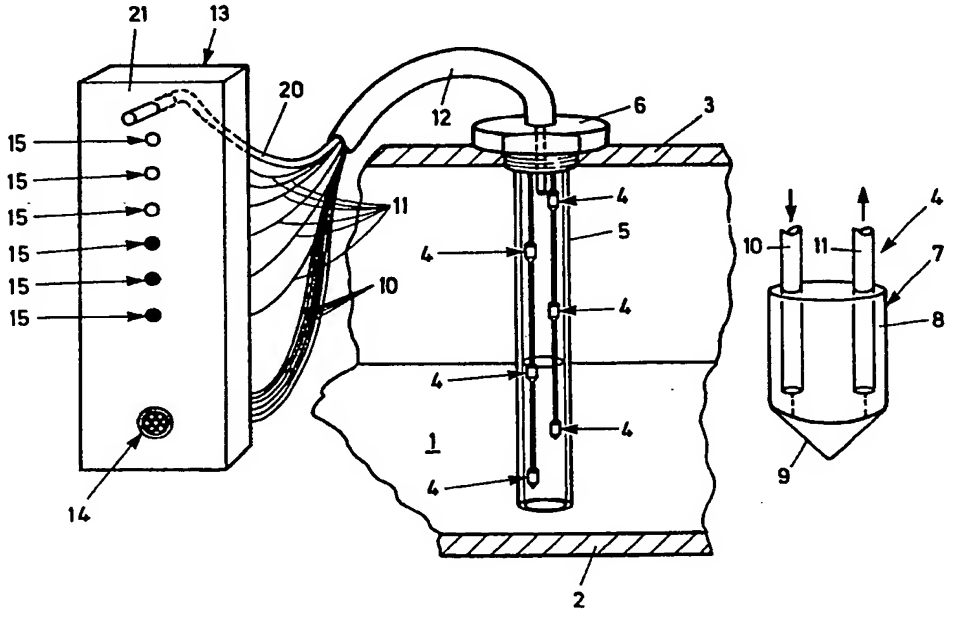
(54) Liquid level sensor

(57) A liquid level sensor provided with means for checking for false indication comprises a vertical, open-ended hollow tube (5) which in use is at least partly immersible in the liquid to be sensed, optical probe means (4) in the tube for sensing preselected liquid levels, and means (20,21) for applying pressurised fluid to the chamber to expel sufficient liquid from the tube to expose at least part of the probe means to the pressurised fluid. A change in the probe output when pressure is applied to expel liquid indicates correct operation. In apparatus to measure gear box oil, air may be applied by mouth via tube 21.



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The drawing(s) originally filed was/were informal and the print here reproduced is taken from a later filed formal copy.

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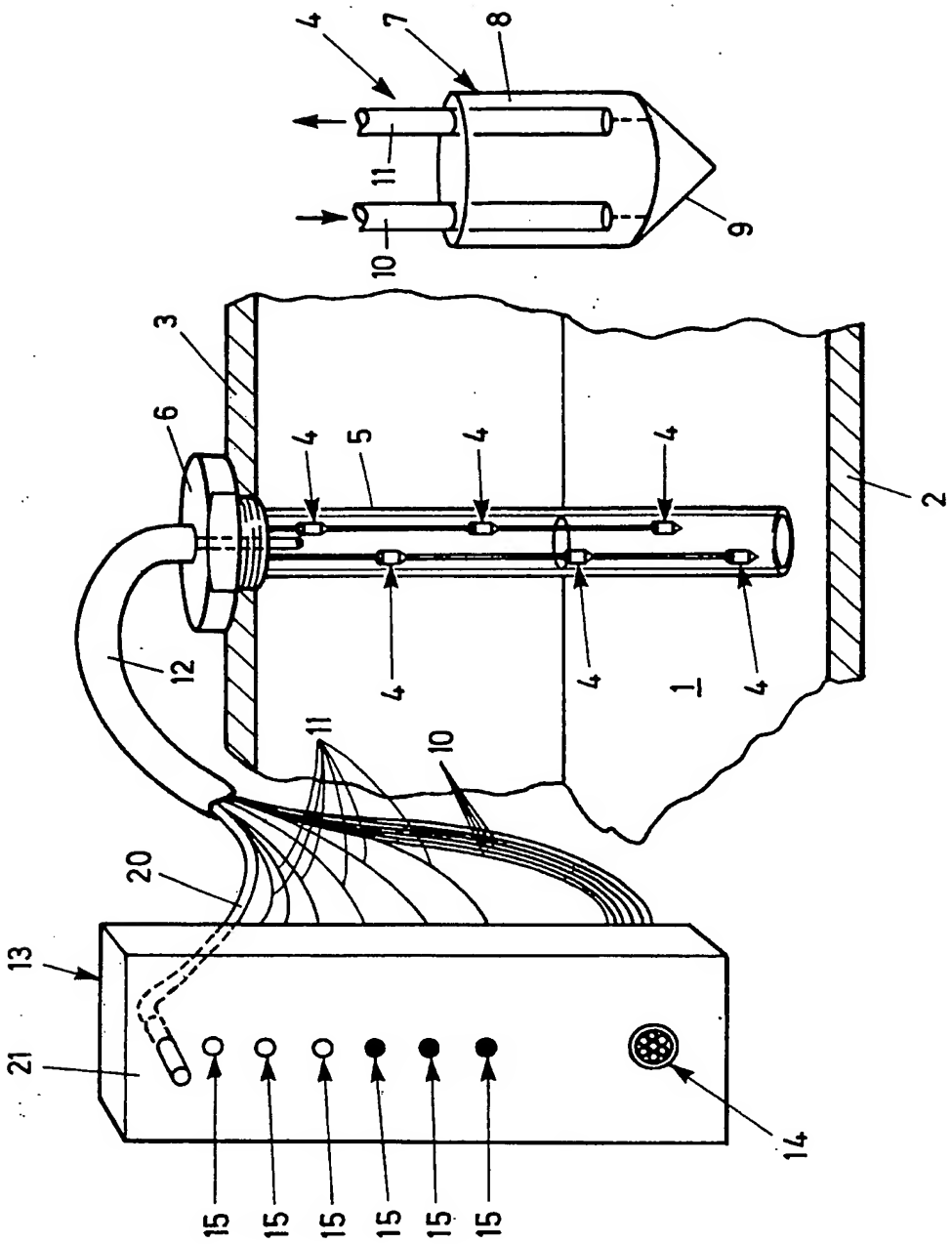

SPECIFICATION

Liquid level sensors

This invention relates to liquid level sensors having optical dipsticks.

In particular, the present invention relates to a liquid level sensor having at least one optical dipstick comprising an optical probe element and a number of optical fibres leading to the probe element. In use, a light signal is fed along one optical fibre to the optical probe element which if situated above the liquid level reflects the light signal towards a second optical fibre which transmits the reflected signal to an indicator element which thereby, is illuminated. If the optical probe element is submerged in the liquid then the light signal is not reflected towards the second optical fibre and the indicator element is not illuminated.

Thus, the state of the indicator element should give an indication as to whether or not the liquid level is above or below level of the optical probe element.

Unfortunately, in some installations as, for example, in a machinery gearbox containing oil, the oil can become progressively more contaminated with mineral particles or dirt which can settle on a reflecting surface of the optical probe element and which thereby, causes the probe element not to reflect the light signal towards the second optical fibre even when the oil level has fallen below the probe element. Thus, in such conditions the liquid level sensor may give a false indication.

An object of the present invention is to provide an improved liquid level sensor which enables a simple check to be carried out to determine if the probe is giving a correct indication.

According to the present invention a liquid level sensor for sensing the level of liquid in a vessel comprises a hollow chamber which in use is at least partly immersible in the liquid to be sensed, a portion of the chamber being connected to an adaptor which in use when the chamber is mounted in the vessel is fixedly securable to the vessel, the chamber having a passage for liquid which in use flows into or out of the chamber as the liquid level in the vessel varies, probe means provided in the chamber for sensing at least one preselected liquid level, and means for applying pressurised fluid to the chamber to expel sufficient liquid from the chamber to expose at least part of the probe means to the pressurised fluid.

Preferably, the probe means comprises a number of optical probe elements arranged to sense liquid at different levels.

Preferably, the or each optical probe element is provided with optical fibres for feeding light signals to and from the optical probe elements.

Preferably, the optical fibres for feeding light signals away from the optical probe elements have their ends which are remote from the probe elements provided with a series of indicator elements mounted on a display panel.

Preferably, the optical fibres for feeding light signals to the optical probe elements have their ends which are remote from the probe elements mounted in light receiver means provided on the display panel.

Preferably, the optic fibres extend into the tube via the adaptor.

Preferably, the portions of the optic fibres extending from the adaptor to the display panel are mounted in a protective hose.

Preferably, the hollow chamber comprises a vertical elongate tube having said passage for liquid formed adjacent to the bottom of the tube.

Conveniently, the means for applying pressurised fluid to the chamber comprises a pipe extending from the tube out of the vessel.

Preferably, the pipe extends from said adaptor to the display panel.

Preferably, a mouth piece is provided on the display panel to enable an operator to apply pressurised fluid to the pipe and hence to the tube by blowing into the mouth piece.

Conveniently, the pipe is located with the protective hose.

Alternatively, the protective hose constitutes the pipe.

By way of example one embodiment of the present invention will be described with reference to the accompanying drawing which is a diagrammatic representation of the liquid level sensor constructed in accordance with one embodiment of the present invention.

The drawing illustrates a liquid level sensor for sensing the level of oil 1 in a vessel as for example a gearbox, the floor and roof of the gearbox casing (only a small portion of which is shown) are illustrated by reference numbers 2 and 3, respectively. The liquid level sensor has a plurality of optical dipsticks 4 mounted in a chamber and arranged at different heights in order to sense a plurality of preselected liquid levels. The chamber is constituted by a hollow vertical tube 5 which is partly immersed in the oil 1 and which is retained in position by an adaptor 6 sealably secured in the roof of the gearbox casing and located in a hole provided in the roof. The top of the tube is sealably and fixedly connected to the adaptor. The bottom of the tube is open to allow passage of oil into or out of the tube as the liquid level in the gearbox varies.

Each of the optical dipsticks comprises an optical probe element 7 (see particularly the enlarged scrap view) constituted by a prism or short length of transparent rod 8 having a 90° conical base 9. Each dipstick provides two optic fibres 10 and 11 extending from the associated probe element 7 up the tube towards the adaptor 6. The optic fibres 10 and 11 provide paths for light signals fed to and

from the associated optical probe element 7, respectively, as will be explained later in the specification. If a probe element is above the oil level a light signal fed to the probe element along optic fibre 10 will be internally reflected twice by the conical base and will pass back up the associated optical fibre 11. However, if the conical base of the probe element is immersed in the oil then a light signal travelling down the optic fibre 10 is not reflected internally at the conical surface and instead passes through the conical surface. Hence, with the conical base immersed no light signal is reflected towards the optic fibre 11.

The optic fibres 10 and 11 from all the optical dipsticks are gathered into a bundle upon reaching the adaptor 6 and are passed through a hole in the adaptor defined by a rigid elbow component (not shown). Upon leaving the elbow component the bundle of optic fibres is threaded through a flexible protective hose 12 which leads the optic fibres to a display panel 13.

The optic fibres 10 for feeding light signals to the plurality of optical probe elements have their ends which are remote from the probe elements mounted in light receiver means 14 provided on the display panel. The ends of the fibres are retained in a holder such that their end faces are directed away from the display panel enabling an operator place an illuminated lamp over the end faces thereby conveying light signals along the optic fibres.

The optic fibres 11 for feeding reflected light signals away from the optical probe elements have their ends which are remote from the probe elements provided with a series of indicator elements 15 mounted on the display panel. As seen in the drawing the indicator elements are arranged vertically on the display panel and each is marked with a caption indicating the state of the oil level in the gearbox. It will be appreciated that if a light signal is reflected at the conical base of a probe element located above the oil then the resulting signal passed along the associated optic fibre 11 will illuminate the associated indicator element. If the conical base of a probe element is immersed in the oil then no light signal is reflected and the associated indicator element is not illuminated. Thus, by placing an illuminated lamp over the light receiver means and by noting the illuminated state of the series of indicator means, the current level of oil in the gearbox is determined. In operation, as the oil level varies the illuminated state of the indicator elements indicates to the operator the current oil level without any need to dismantle the part of the gearbox.

The liquid level sensor also comprises means for applying pressurised fluid, as for example, pressurised air to the inside of the vertical tube to expel sufficient oil from the tube to expose the probe elements to the pressurised fluid.

The means for applying pressurised fluid to the inside of the tube comprises a pipe 20 extending from the tube and out of the gearbox via the adaptor 6. The pipe is accommodated together with the optic fibre bundle in the protective hose leading to the display panel. Upon reaching the display panel the end of the pipe is connected to a mouth piece 21 to enable an operator to apply pressurised fluid to the pipe and hence to the tube by blowing into the mouth piece. In normal operation the pipe provides an air vent to the tube as the oil level varies.

Thus, when using the liquid level sensor to sensor the level of oil in the gearbox the operator may check that the probe elements are functioning correctly by placing an illumination lamp over the light receiver means and simultaneously blowing into the mouth piece on the display panel. As the pressurised air expels the oil from the tube to sequentially expose the probe elements to air the indicator elements should illuminate. If any of the indicator elements does not illuminate it is an indication that the probe element is not functioning correctly and the adaptor 6 is disconnected from the gearbox roof and the tube containing the dipsticks is removed for examination and maintenance.

In another embodiment of the invention the protective hose provides the passage for pressurised fluid to the tube, the mouth piece being sealably connected to the hose via a sealed chamber.

In other embodiments a filter element is provided over the opening at the base of the tube to reduce the amount of contaminent entering the tube to contact the probe elements.

In further modifications the mouth piece is replaced by any other suitable source of pressurised fluid as for example a compressed air mains supply, a gas compressor or a pressurised fluid cylinder.

In still further modifications the apex of the conical base is cut away to leave a small horizontal surface which may be backed drilled to provide a borehole extending into the conical base. Such a modification tends to reduce the tendency for any liquid to be retained by the probe element upon the liquid level falling below the probe element.

CLAIMS

1. A liquid level sensor for sensing the level of liquid in a vessel, comprising a hollow chamber which in use is at least partly immersible in the liquid to be sensed, a portion of the chamber being connected to an adaptor which in use when the chamber is mounted in the vessel is fixedly securable to the vessel, the chamber having a passage for liquid which in use flows into or out of the chamber as the liquid level in the vessel varies, probe means provided in the chamber for sensing at least one preselected liquid level, and means for

applying pressurised fluid to the chamber to expel sufficient liquid from the chamber to expose at least part of the probe means to the pressurised fluid.

2. A sensor as claimed in claim 1, in which the probe means comprises a number of optical probe elements arranged to sense liquid at different levels.

3. A sensor as claimed in claim 1 or 2, in which the or each optical probe element is provided with optical fibres for feeding light signals to and from the optical probe elements.

4. A sensor as claimed in claim 3, in which the optical fibres for feeding light signals away from the optical probe elements have their ends which are remote from the probe elements provided with a series of indicator elements mounted on a display panel.

5. A sensor as claimed in claim 4, in which the optical fibres for feeding light signals to the optical probe elements have their ends which are remote from the probe elements mounted in light receiver means provided on the display panel.

6. A sensor as claimed in claim 4 or 5, in which the optic fibres extend into the tube via the adaptor.

7. A sensor as claimed in claim 4, 5 or 6, in which the portions of the optic fibres extending from the adaptor to the display panel are mounted in a protective hose.

8. A sensor as claimed in any one of the preceding claims, in which the hollow chamber comprises a vertical elongate tube having said passage for liquid formed adjacent to the bottom of the tube.

9. A sensor as claimed in any one of the preceding claims, in which the means for applying pressurised fluid to the chamber comprises a pipe extending from the tube out of the vessel.

10. A sensor as claimed in claim 9, in which the pipe extends from said adaptor to the display panel.

11. A sensor as claimed in claim 10, in which a mouth piece is provided on the display panel to enable an operator to apply pressurised fluid to the pipe and hence to the tube by blowing into the mouth piece.

12. A sensor as claimed in claim 11, in which the pipe is located with the protective hose.

13. A sensor as claimed in claim 11, in which the protective hose constitutes the pipe.

14. A liquid level sensor substantially as described herein and substantially as shown in the accompanying drawing.

Printed in the United Kingdom for
Her Majesty's Stationery Office, Dd 8818935, 1986, 4235.
Published at The Patent Office, 25 Southampton Buildings,
London, WC2A 1AY, from which copies may be obtained.